Design and Technology Education: An International Journal
26.4

Global Design Studio: Advancing Cross-Disciplinary Experiential Education During the COVID-19 Pandemic

Shital Desai, York University, Canada
Ingrid Stahl, Technische Hochschule Ingolstadt, Germany
Marianella Chamorro-Koc, Queensland University of Technology, Australia

Abstract:
The COVID pandemic forced universities worldwide to shift to remote and online formats of teaching delivery. In design education, this shift has impacted Experiential Education (EE) pedagogical approach to studio teaching, an approach that gives students an opportunity to apply theory to a concrete experience in a reflective manner and provides cross-disciplinary learning opportunities. This paper discusses Global Design Studio (GDS), a collaborative cross-disciplinary teaching initiative between three design disciplines across three continents: Industrial Design in Australia, Interaction Design in Canada, and User Experience Design in Germany. The objective was to develop a support framework during emergency situations to facilitate cross-disciplinary EE to design students. This paper discusses the three teaching experiences as case studies that offer opportunity for deep analysis and reflection of challenges and enablers to EE education in the shift from traditional design studio to remote and online delivery. While navigating COVID-19 barriers to EE education, GDS aimed to achieve these objectives by sharing resources, ideas, and expertise across the three universities. Each unit dedicated the entire academic term to a first exploration of GDS through a semester-long project 'Interactive Mannikin for children to learn CPR techniques'. This article discusses the context and outcomes of EE teaching and learning experiences at each unit. This paper also reviews the lessons design educators learned about: inter disciplinarity, inter-intra-cultural issues, group working, timing, remote collaboration, and proposing a GDS model for cross-disciplinary EE.

Keywords
experiential education, higher education, design education, product design, interaction design, user experience,

Introduction
Experiential studio-based learning fosters critical thinking and interpersonal skills. It prepares students to work on real-world projects and acquaints them with issues they will encounter in the workplace (Strait & Sauer, 2004). Developed from the tradition of 'learning by doing', design studios are recognized as the signature pedagogy for creative disciplines (Chamorro-Koc & Kurimasuriyar, 2020). Cross-disciplinary education is an important component in design education with the emergence of new technologies and human-centred design research methods which are applied to real-world multidisciplinary contexts.

Due to COVID-19 social distancing requirements, the shift of our studio classes to online and remote delivery formats critically impaired students' experiential learning and our teaching in

design studios (Christian et al., 2020). The shift disrupted cross-disciplinary student learning as access to resources, such as experts and community partners, was restricted, and communication between all stakeholders involved in the teaching and learning process was impacted.

We created a 'Global Design Studio' (GDS), a cross-continental, cross-institutional and cross-disciplinary initiative, to mitigate challenges imposed by COVID-19 in design studio-based learning experience and cross-disciplinary design education. The goals of GDS are (1) to create a real-world project for students to work on, (2) to provide a design studio experience for students through 'learning by doing' activities integrated into the course (3) to facilitate sharing of cross-disciplinary guest lectures and resources, specifically in the following three areas of authors' expertise: interaction design, experience design and product design, and (4) to provide avenues for students and course directors to reflect on their learnings and experiences.

To meet GDS goals and objectives, the authors collaborated to deliver remote studio courses in industrial design, interaction design and user experience design in their respective institutions. The collaboration focused on developing a design brief, experiential learning activities based on principles of 'learning by doing,' resources to support carrying out these activities and materials to facilitate student assessments and reflections of their work. In the following sections, we describe background literature and previous work on studio-based design education and cross-disciplinary learning. We then provide a description of GDS to navigate barriers presented by COVID-19 restrictions. Finally, we present lessons learnt, future directions for GDS, and propose a framework for GDS's approach to cross-disciplinary studio-based education in COVID-19 and other similar emergency situations. We also believe that instructors could easily integrate GDS framework to non-COVID situations, which will have to be evaluated in future.

Background

Experiential Learning in Design Education

Experiential Education (EE) is the application of theory to a concrete experience, either within the classroom or within the community, which advances the learning outcomes of a course or program and requires students to reflect upon their learning. EE involves experiences that (1) encourage active learning and (2) include structured reflection, motivating students to make sense of it by considering relevant course material. Reflective learning exercises integrate student learning experiences with the concepts/theories addressed in the class (Ryan & Ryan, 2013).

Experiential learning is a process in which knowledge is attained through the transformation of experience (Kolb, 2014, p.304). John Dewey's experiential learning theory suggests that learning happens in a social context, and knowledge is generated through real-life experiences. Thus, a teacher's role is to facilitate experiences that provide context for course content (Roberts, 2003). EE allows students to adapt their learning to their abilities and readiness to learn. Each student generates new knowledge unique to their quality of experience which they apply to new situations resulting in the construction of new knowledge.

Opportunities are thus created for students to 'experience,' which are then reviewed, reflected upon, and assessed in three stages: reflective observation, abstract conceptualisation, and

active experimentation. Students consciously experience new learnings and concepts. These individual experiences of learning a new skill or improving upon a practice are recorded with specific examples, in which the students explain their observations, feelings, and thoughts. Students reflect upon their notes by asking questions such as: what worked? What failed? Why did the situation arise? What did others do? During the abstract conceptualisation stage, an individual questions their own reflections using guiding questions such as: what could I have done better or differently? How can this be improved? People identify different ways to deal with the same experience and develop improvement strategies through consultations with experts and peers, resulting in new ideas. Students then apply and practice their newly acquired theoretical knowledge and ideas. Some ideas will work, and others will not, which will form the basis for a new cycle of the experiential learning model, as the experiences in the active experimentation stage become new concrete experiences. Thinking and reflecting about the experience is central to EE. Reflective thinking on experiences generates understanding and transformation of experiences to knowledge (Baker et al., 2002).

Studio-based learning can be used to introduce experiential design education in classrooms, whereas pedagogical strategies are based on semi-structured learning around a project and problem-based learning (Crowther, 2013). Design studios provide an engaging mode of learning by doing and making. Students create and reflect upon iterations of prototypes varying in fidelity for new explorations. A design challenge or open-ended design brief is provided and students iterate their design and development through critiques from the lecturer and peers (Cennamo, 2016). Studio activities include ideation sessions such as co-design workshops (Boudhraa et al., 2021), 'doing' and 'making' tasks, such as prototyping using sketching and situational materials (Tovey, 2015; Vyas et al., 2013), guest lectures (Ham & Schnabel, 2011), and role-play of ideas (El Zeini et al., 2021; Gencosmanoglu et al., 2011). Studios can occur outside the classroom setting, such as during a field visit to a course-relevant site, an interview with users or professional in the field, and participation in a community event (Cameron et al., 2001).

Another pathway for EE is through involvement of a community partner in the teaching and learning process. Community-focused EE begins with instructors collaborating with partners to understand their needs, areas of investigation, design, and development. Though EE can happen within or outside of the classroom, the partner is involved at every step of the learning process. With the advent of design methods that focus on designing with a project's stakeholders, instructors are increasingly applying community-focused EE methods in their classrooms. However, there is limited literature discussing the methods and outcomes of community-focused EE. Cook & Cutting (2014) conducted a year-long research project that investigated student engagement with communities that derive self-reliance from local natural resources. When asked to evaluate the experience, student responses ranged from enthusiasm to skepticism, while community members provided a direct recount of the context, living close to nature with limited resources. This discovery allowed students to discuss and develop reflections and make connections between the theory of sustainability that they were familiar with and their experiences.

In the North American winter of 2020, the COVID-19 pandemic forced all post-secondary teaching and learning to convert to online or remote formats. Moving studio and community-

focused learning online presented challenges such as a lack of access to community partners and stakeholders for user research. In addition to facing challenges at professional and personal fronts, instructors had to move physical and tangible studio activities to a remote format. Christian et al. (2020) proposed an integrative model for implementing EE in online teaching during COVID-19. The researchers combined Schoel & Maizell's (2002) adventure wave with Kolb's (2014) experiential learning cycle into three phases. During the briefing phase, each activity is explained to the students. Next, during the 'doing phase,' students perform the experiential activities. Finally, during the debriefing phase, students reflect on the experiences, discuss their significance, and identify how they will apply their new knowledge. Christian et al. (2020) discuss two case studies of theory courses where the proposed model was used. In the briefing session, (subject) introduce an existing theory to the students who then explore the concepts in the doing and debriefing sessions.

However, the 'doing phase' in design education also involves making iterative prototypes of varying fidelity along with carrying out experiential activity.

Cross-disciplinary Education

Disciplinary knowledge and skills are limited in how they address real-world problems in a connected world that are challenged by global health and environmental issues (Meyer & Norman, 2020; Mok, 2009; Self & Baek, 2017). With advancements in technology, the emergence of knowledge-based society, and design increasingly being seen as a tool to create opportunities and solutions to meet United Nations sustainable development goals, it is important for design students to gain cross-disciplinary knowledge and the ability to work across disciplines (Self et al., 2019). For example, it is important to consider what skills and knowledge are required for designers to develop appropriate IoT design solutions and how designers can contribute to the solution of complex systemic problems.

Schaffer et al. (2012) refer to cross-disciplinary learning as an ill-structured learning environment but with improved results in terms of student efficacy. Similarly, the significance of collaborative learning and social learning in cross-disciplinary settings is evident (Machemer & Crawford, 2007; Pennington, 2008). Student success was evaluated through questionnaires and GPA score improvements. Design education involves multidisciplinary engagements at two different levels: context-based engagements and design-specific engagements. Application-based engagements provide information about the context of design, such as better understanding of the issues at hand. In contrast, design disciplinary engagements provide different perspectives and approaches to the same problem. The COVID-19 pandemic affected both engagements and it was the objective of GDS to transfer cross-disciplinary learning to online/remote formats through cross-continental collaborations.

Methodology

Global Design Studio Background

GDS involves three design educators and researchers with a common interest in the design of interactions and experiences. They teach product design, interaction design, and UXD on three continents, in Australia, Canada, and Germany respectively. These three locations are learning and teaching nodes for co-disciplinary GDS collaboration. Marianella Chamorro-Koc's research experience is in the design of health technologies. As a design educator in Industrial Design, she

specialises in the course design and delivery of 'interactive product design' at the Australian L&T node of GDS. This course focuses on tangible interactions and requires interactive prototyping with a sustainable and local manufacturing approach.

Ingrid Stahl brings extensive industry experience to User Experience Design (UXD) education at the German L&T node of GDS. As an educator, Ingrid Stahl specialises in medical and healthcare technologies and UXD of screen-based interfaces. Marianella Chamorro-Koc and Ingrid Stahl have collaborated on previous interaction design projects.

Shital Desai is a researcher in inclusive and accessible interaction design. As a design educator at the Canadian L&T node of GDS, she teaches courses in human computer interaction and speculative and systems design. Shital Desai and Marianella Chamorro-Koc are former colleagues at the Australian L&T node and have both worked together on the interactive product design course.

The GDS initiative brought together three experts in interaction design in three different applied disciplines to collaborate on facilitating cross-disciplinary EE to their students during COVID-19. The previous associations between the authors provided a context for peer collaboration. Reflection-on-action was possible through iterative and continuous communication which was achieved by overcoming time zone differences, varying cultural and pedagogical settings across the three student cohorts, interdisciplinary distinctions, and differing expectations in terms of students' learning outcomes.

Our previous collegial experiences and motivations around developing appropriate learning experiences for our students prompted the opportunity to collaborate. The initial motivation was to address the problems imposed by COVID-19 conditions in which our design units could not support our students' 'learning by doing', peer learning, prototyping and in-class feedback. Given semester time differences, our GDS collaboration started in July 2020 at the Australian L&T node, followed by the Canadian L&T node in September 2020, and then by the German L&T node in October 2020. The collaboration setup consisted of:

- One design project brief: defined by the Australian L&T node, and then adopted and adapted by the Canadian L&T node and German L&T node, according to the learning requirements for their units.
- Students' international collaboration: Students in the Australian (Product design) and Canadian (designed interactions) L&T nodes volunteered their final designs as starting point for the students in the German (Interface design) L&T node.
- Lecturers' international collaboration through digital tools: Padlet, video recorded guest lectures, zoom meetings.
- Involvement of industry partners and stakeholders: the project emerges from a real-world need and therefore, community participations (industry and relevant stakeholders) were sourced at each university to work with the students' cohort.

The Design Project: Designing an Interactive CPR Manikin to Teach Children the Technique

Marianella Chamorro-Koc's research in design for health, in collaboration with Clinical Skills Development Services from the Metro North Hospital and Health Service (MNHHS) in Queensland (Australia), had identified the opportunity to develop a low-cost simulator to teach the community the cardiopulmonary resuscitation (CPR) technique. From an industry perspective, most manikins (or simulators) are computerised and involve advanced manufacturing processes which makes them costly and specialised for clinical use and professional training. Other manikins for community training (e.g., Red Cross training) offer lower cost solution, but are not dedicated to the broader community. For example, CPR training is not offered for children at primary schools. This discrepancy introduced a design problem and familiar context in which students could engage with the project.

Children as young as 9 years old could learn the basics of CPR, and countless examples demonstrate that children can save lives by performing CPR. Although children might not have physical strength, it is known that children possess the cognitive skills to apply the compression technique correctly. Different organisations worldwide support the importance and appropriateness of giving CPR education to children in schools. How can designers help children learn and apply the technique correctly in the context of a primary school classroom? This was the design problem presented to the three students' cohorts in the three universities. The design problem was addressed as: an interactive child size manikin at the Australian L&T node, an embodied interaction experience at the Canadian L&T node, and as a UXD interface design (mainly App) at the German L&T node. The following sections describe the work done at each university.

Australian Approach: Industrial Design

In 2020, Marianella Chamorro-Koc developed a new 2nd year Industrial Design course: Interaction and Experience, which provided the foundation for the CPR interactive manikin design project. In this course, the key student learning outcome is the application of interactive design theories into making functional interactive manikin prototypes.

We used double diamond iterative design approach in the design of an interactive manikin, consisting of four phases: discover, define, develop, and deliver:

- Phase 1 Discover: Students explored and discovered user needs from the concrete experience of a clinician whose expertise is to deliver training with human simulators to train physicians. This understanding is traditionally supported with hands-on experiences. However, due to COVID-19 restrictions, we replaced this aspect with videos of making of those specialised simulators at the hospital, including an expert interview where a simulator was deconstructed in front of the camera for students to understand the object. The exploration of user experiences of the intended end-user —children, parents and teachers— was part of the students' end-user investigation. Therefore, in this case, gaining insights from a concrete experience was supported in a different manner. Students were asked to annotate their progress to discuss with tutors in an online journal, which tutors could review at any time, and students used to track their progress and to demonstrate the work done to their tutors.

- Phase 2 Define: Students defined and produced individual concept designs and, as a group, selected ideas and features to integrate into one concept to model make. Model making has had a profound effect on the designs. Designs have improved dramatically since weekly workshop access began in the second half of the semester. Through the 'hands-on' model making experience, students were able to test the interactions and enhance their understanding of the design problem and opportunities for improvement. The students' video recorded their models, testing, and iterative work. This work was registered in Padlet, where there were 3 different Padlet boards, one for research collaboration, another one for concept design, and a last one for final presentations. Padlet boards provided the vehicle for in-class (online) consultation and presentation of ideas to the entire cohort of students.

- Phase 3 Develop: Although students worked in teams of 4, the project provided opportunity for individual learning through a discover-define-develop process. This process was focused on manikin part design. Each member of the student team chose what part of the manikin they would develop in terms of the technical specifications for manufacturing. Once again, the weekly reports and consultation with tutors, as well as their recordings in Padlet, provided the opportunity for students to reflect on their work, see other students' work, and discuss their progress with the tutors. Individual focus on part design**:** Students were all required to do some CAD and to do product development of their individual part of the overall design.

- Phase 4 Deliver: Padlet was used to record students' process and progress, but also provided the means for remote presentation of the project to the industry partner. The delivery consisted in a fully working prototype that can be seen in our Padlet board in Figure 1, and in videos demonstrating how the manikin works, its value proposition, as well as the part design for product development.

The team at the Australian L&T node of GDS had to adapt the course for online/remote teaching in the following areas:

Making and Doing activity: A key challenge in this course is to teach industrial design students to use Arduino technology to 'make and demonstrate' interactions with the manikin. Prior to COVID-19 restrictions, this was solely done through in-class face-to-face workshop sessions introducing students to physical and material interactions using Arduino and fabrication technologies. In the shift to teaching online following COVID-19 restrictions, Marianella Chamorro-Koc engaged a team of tutors (teaching assistants) in developing strategies and resources to provide a supportive learning environment in remote, online, and asynchronous teaching and learning conditions. Aware of the challenge of making prototypes at home without materials or tools, Marianella Chamorro-Koc redesigned the course content to support students in achieving a viable learning outcome. One of the essential strategies was to replace the face-to-face workshops and demonstrations with the making of interactive prototyping demonstration videos.

Sharing design iterations: Studio-based collaborative learning spaces were replaced with Zoom facilitated virtual spaces. Marianella Chamorro-Koc employed Zoom (a synchronous format) in combination with Padlet (an asynchronous format) for collaborative learning in place of design

studio classes. Aiming to provide a similar collaborative environment to our traditional design studios, students posted sketches and videos of their designs on Padlet to share with their peers, in the same manner as pinning their sketches up on a wall. They then had live presentations with feedback and discussion, alongside the additional potential for students to 'like' each other's designs and for tutors to write comments on Padlet. This combination of a synchronous and asynchronous approach was effective in creating a supportive learning environment where students could review feedback and build on ideas, and for tutors to review timelines of student progress. Meetings with tutors during and after each session allowed us to reflect-in and on-action and effectively support them improve their teaching practices.

Field visits and experience: The concrete experience of students attending the hospital and interacting with real manikins had to be replaced by a recorded guest lecture about CPR and a demonstration of a clinical manikin by our industry partner, made available online. The synchronous learning that would normally take place through hands-on activities to address design problems had to be replaced by asynchronous and remote interactions via email and class discussions on zoom.

Figure 1. shows Australian GDS L&T node's Padlet and their outcomes in their final design presentations through prototypes, design fiction videos, and posters (available at: https://padlet.com/mchamorro8/HealthTech).

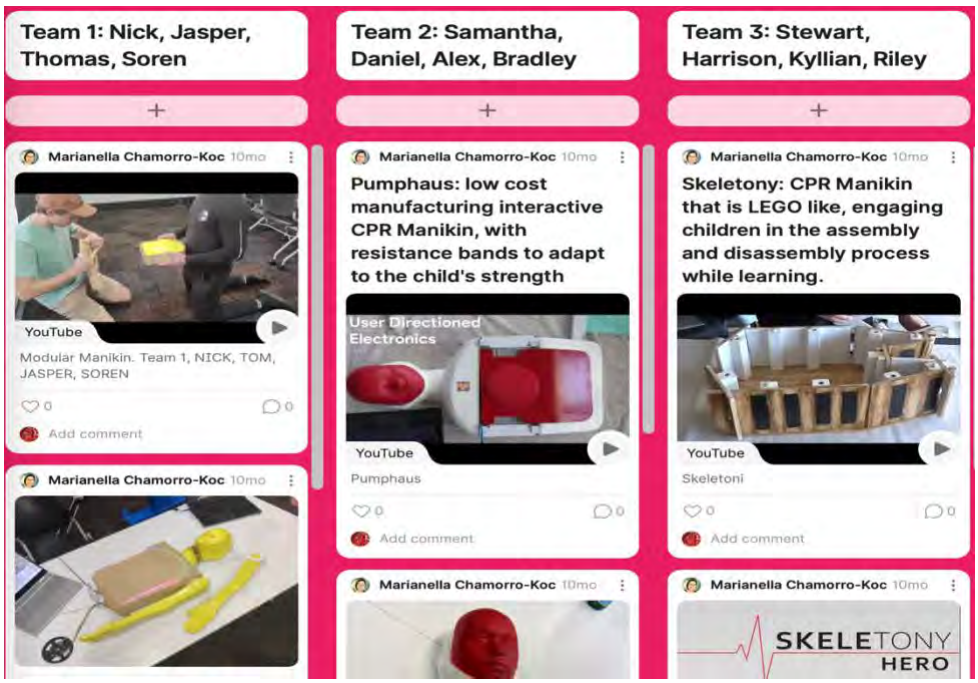

Figure 1. A section of the Padlet board from the Australian L&T node of GDS

Canadian Approach: Interaction Design

'Designing for Human Interactions' is a 2nd year, 3 credit course, in the department of design at the Canadian L&T node of GDS. The course introduces design students to the concepts of interaction design: tangible and embodied interactions, focussing on human interactions with

digital, physical and mixed reality interfaces. Students learn inclusive and accessible design of tangible interactive interfaces to meet user needs, through human-centred design principles and user research methods.

In the fall semester of 2021, students worked on a semester long project -'designing interactions with a Manikin for children learning CPR technique'. This project focussed on designing interactive interfaces and devices to help children learn CPR techniques through interfaces that respond to tangible interactions.

To provide students with expert consultations and ongoing critiques on CPR training and accessible design principles, Shital Desai partnered with Rebecca Boyd, manager of intramural sports, sport clubs, aquatics, and first aid and Melanie Baljko, an expert in accessible design at Lassonde school of Engineering. GDS members also provided guest lectures through pre-recorded lectures.

Students and faculty did not have access to the university campus resources as fall and winter semester teaching was entirely carried out remotely. A four-hour class each week consisted of a one-hour lecture followed by a three-hour studio session. Lectures focused on introducing principles of interaction design (affordances, metaphors, conceptual and mental models, embodied, tangible, and intuitive interactions), accessible design, and designing for children. Studio sessions included synchronous and asynchronous hands-on activities that provided experiential learning on the concepts introduced in the class. These activities included using cultural probes, sketching interactions, carrying out observations and user research, expert critiques, and peer feedback. Three dimensional and computational prototyping was not possible as students did not have access to the fabrication lab and physical studio space. Thus, prototyping was carried out using techniques outlined by Buxton (2010) and Greenberg et al., (2011) on sketching experiences and interactions.

Students used an iterative design process that involved four phases of the double diamond model – Discover (establish user needs), Define (interpretation and alignment of findings to project objectives), Develop (design led concepts and proposals iterated and assessed), and Deliver (process outcomes finalised and implemented) (Jaye et al., 2015). Kolb's reflective learning model suggests that reflection is important for EE education which was integrated in each of these four phases of the design process through following weekly activities and assignments:

- Reflective journal: students reflected on their weekly design process in a journal asking questions such as: what worked for them, and what did not? They asked 'why' and 'what if' questions to brainstorm ideas and alternatives for next step forward.

- Process work: doodling and sketching helped designers to "think differently, generate a variety of ideas quickly, explore alternatives with less risk, and encourage constructive discussions" (Leblanc, 2015). Students used sketching as a visual communication tool; however, they found it difficult to use it as a thinking or a design tool for problem solving and ideation. Thus, every sketch representing a design idea was critiqued by peers and experts. Students were encouraged to use cultural probes, personas, narratives and

storytelling and other tools to understand user and systemic context to refine their ideas. The process work was evaluated for evolution of the idea, justification of the design choices, discrimination and refinement, the pertinence of the signs, visual cues and analogies used to express and communicate design features.

- Peer and expert critique: Sketches representing design ideas and conceptual models of the design are critiqued by peers and experts synchronously on Zoom sessions, either in the main room during student presentations (for example interim progress presentations), or breakout rooms and asynchronously on Padlet, Miro, discussion forums on e-class, and outside consultations (requested by students via Calendly).

COVID-19 prevented in-person field work and site visits. Thus, concrete experience was facilitated through video observations and demonstrations, expert consultations and lectures, and the research assignment that covered user research and technology explorations. User research methods included surveys, interviews, and observation studies which were then synthesised using People, Activities, Context, Technology (P.A.C.T) analysis and clustering methods such as affinity analysis (Bateni et al., 2017). GDS members contributed their expert knowledge through pre-recorded lectures and demonstrations. Every experience was reflected upon in a reflective journal, prototyping and peer feedback, and expert critique to inform next level of exploration in the design process. This contributed to a new concrete experience. GDS members contributed resources on prototyping which allowed students to develop a personal prototyping strategy depending on individual personal situations. Some students used materials available at home, such as a cardboard and paddle pop stick, while others used sketching as a tool to conceptualise their design through motion graphics and animation tools.

Finally, all the individual projects submitted by the students were evaluated by a group of CPR trainers (represented by Rebecca Boyd) to identify three projects that could be commercialized further and led by the student and mentored by author 1. Figure 2 shows the Padlet board of students' final design (poster, conceptual prototype, and presentation) at the Canadian GDS L&T node (https://padlet.com/satslab/6sfn7xbkml1ghq04).

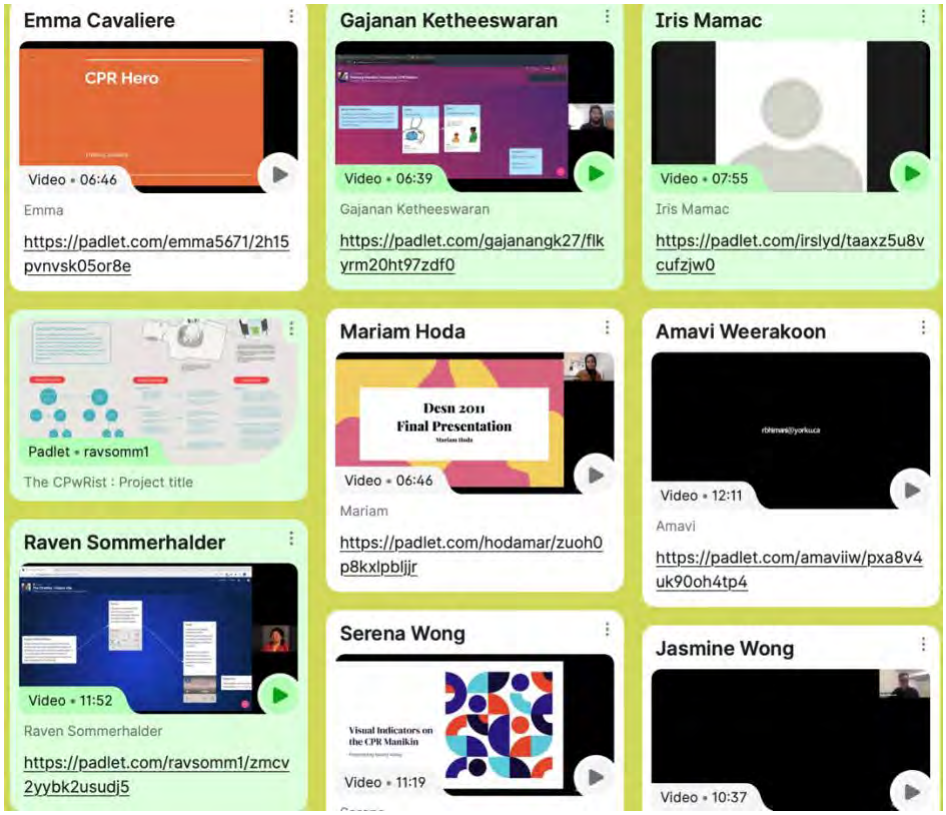

Figure 2. A section of the Padlet board from the Canadian L&T node of GDS

German Approach: UXD at THI

The UXD students at the German L&T node created user interfaces based on the projects developed by the product design and interaction design students in the Australian and Canadian L&T nodes of GDS respectively. During the first few weeks, the students in the German L&T node had weeks on-campus, face-to-face learning which allowed them to get started with the course. Students met with an expert, Dr. med. Micha Bahr, Director of the Clinic for Pediatric and Adolescent Surgery in Ingolstadt (Germany) and CPR trainer for children. Then, the course was transitioned to online/remote teaching and learning which mostly happened on Zoom. While each team of students presented their designs to the entire class on weekly basis, they also took feedback and critique from a partner in breakout sessions. The German team used Moodle/e-class as a central place for sharing course content and submitting assignments and a Miro Board for brainstorming, Sketching (analog and digital), Adobes Creative Cloud (Illustrator, Photoshop, Adobe XD, After Effects, Premiere), and Figma.

Cross-disciplinary EE was integrated into the double diamond design process. Students worked in teams of two. The model was integrated in this process through weekly activities:

- Phase 1 Discover: Students brainstormed and discussed the projects developed by students in the Australian and Canadian L&T nodes. They researched about CPR and consulted experts in CPR training.

- Phase 2 Define: Students focused on two different target groups for the design of the interface: children as primary stakeholders and trainers as secondary stakeholders.

Therefore, they designed two different concepts in terms of paper prototyping (analog or digital) and Wireframing (Garrett, 2010; Krug, 2018). The concept was demonstrated in a clickable prototype that was used for small usability tests. Feedback from potential users and the expert, Dr. Micha Bahr, was incorporated in the final designs.

- Phase 3 Develop: Each student team created their own Persona, Mood board and Screen design for a specific use case (Steane, 2014). The students developed a storyboard to incorporate the use of the interface in the final submission and presentation (Butz et al., 2014). Students received feedback from the instructors every week during the virtual studio class.

- Phase 4 Deliver: Students presented their work on Zoom and submitted their designs with documentation and their final movie on the Padlet.

By the end of the semester, each team was able to present comprehensive and thorough work, showing all important parts of a UXD process with a focus on a specific target group and visual design (Hassenzahl, 2013; Rosenzweig, 2015). The German GDS L&T node developed interfaces for tangible products created by students in Australian and Canadian nodes.

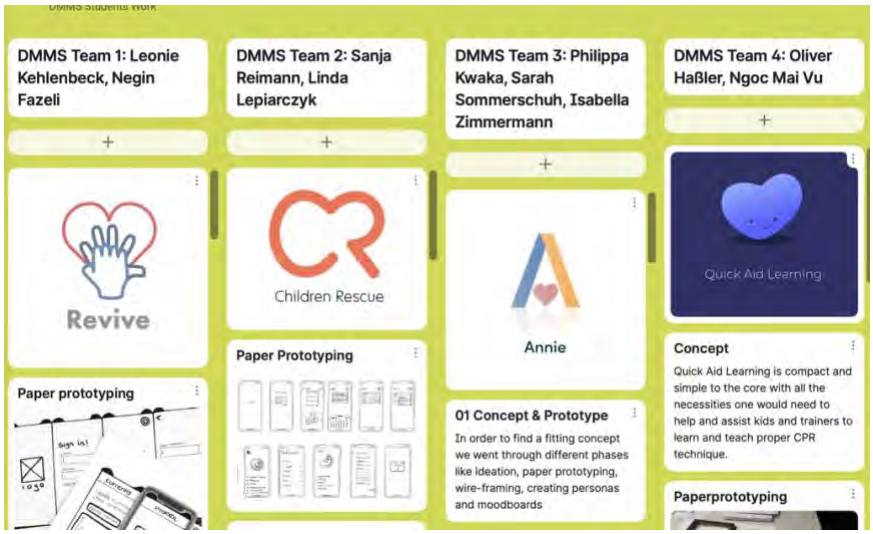

Figure 3. A section of the Padlet board from the German L&T node of GDS

Discussion

To navigate challenges presented by COVID-19 to cross-disciplinary EE, the three nodes of GDS attempted to collaborate in delivering three design courses in three disciplines of industrial design, interaction design, and UXD. The objective was to find ways in which the student engagement and experience in a traditional studio-based learning environment in these courses is maintained in a virtual environment. At the same time, it was crucial to maintain the learning outcomes stated in our design courses descriptions as these students were 2nd year design students and the learnings from this course would impact their performance in the courses they take in the 3rd and 4th year of the design programs. The three case studies highlighted following themes around adaptations and implementations of cross-disciplinary EE during COVID-19 where GDS played a critical role in making an impact. It has resulted in a GDS

model for cross-disciplinary EE (Figure 4) comprising: collaborative briefing and real-world approach, sharing of resources for remote and local activities, and cross-disciplinary collaboration.

Collaborative Briefing & Real-word Approach

All three L&T nodes experienced challenges in developing a design brief or a project for their course. In traditional format, the project would normally be informed by their ongoing research. Research outcomes and collaborations, both industry and community-based, developed during the process participated in the teaching process. However, COVID-19 had impacted this entire cycle. GDS took advantage of the fact that all three L&T nodes experienced COVID-19 waves at different times. Also, the courses were run at different times of the academic calendar. Thus, the design brief or the project initiated from the Australian L&T node was adapted by others to meet learning outcomes requirements of each specific course.

In each design course, the project briefing was carried out in two parts. First, students were briefed on the entire project and course. Then, they were briefed on individual activity (weekly studio activity, assignment, or a design process). Each of these briefs included a 'why- objective' or goal; they were instructed to 'do' (perform the activity) and 'think' (reflect on the experience). A briefing template as a resource emerged during this process.

Sharing of Resources to Remote and Local Activities

Each L&T node of the GDS developed their own activities for students to experience, assignments and evaluation criteria. Students were asked to reflect on their experience in weekly journals and virtual pin-up boards (such as Padlet and Miro). Authors shared these activities from each of the GDS L&T nodes with each other to be used in each of the courses.

Since each L&T node was progressing through various COVID-19 waves and occurring at different semester times, certain activities were feasible in some L&T nodes but not in others. Sharing findings and experiences of the students in each L&T node helped mitigate these accessibility barriers. This communication was especially useful in the discovery phase of the project when, for example, students in the Canadian L&T node could not conduct rigorous, in-person user research. Thus, they were limited to distributing surveys which were able to understand users and their behaviours.

Cross-disciplinary Collaboration

To facilitate student engagement with the content related to the project context (CPR training in children), each L&T node developed local collaborations with content experts. The local experts also provided critique to students in the local L&T node. The three L&T node coordinators/authors provided expertise in design disciplines on topics relevant to the project. For example, author 1 provided a guest lecture on embodied interactions in children, while Ingrid Stahl provided lectures on user experience design, and Marianella Chamorro-Koc gave a guest lecture on user research and information synthesis. Each GDS L&T node also developed resources on various design topics through local experts. For example, Marianella Chamorro-Koc developed video tutorials on Arduino-based computational prototyping and talks from experts on how to prototype using materials available at home. Shital Desai developed resources and explained how to use sketching and storyboarding to narrate design ideas and

prototype these ideas. All the content delivered by the experts were either pre-recorded and incorporated as a to-do item in weekly activity or presented in a virtual class (which were also recorded).

As the course progressed and students gained new knowledge, we noticed that students also became experts in their domain knowledge. This was evident in weekly discussion forums where the postings became richer in content as the semester progressed. Students met the required learning outcomes which was made evident in their final presentations and submissions of their project work. They proved their skill and ability to produce successful prototypes. At the Canadian L&T node, one of the designs won the Best Project Award at an undergraduate research competition and three designs were shortlisted for further development into a product for commercialization. The overall average student grade in the class was A (10-point grade scale).

GDS, a collaborative remote platform to explore delivery of interaction design content for our students, demonstrates that the key to this collaboration is the setup of the project, communication between the group members, student peer collaboration, and the sharing of online resources for teaching, learning and peer-work. One core aspect of GDS is peer-to-peer learning, which was incorporated in a unique way. Direct peer-to-peer collaborations were not possible due to differences in time zones and semester timelines. This worked perfectly well for us as students from one cohort informed their peers from the other two cohorts of their design outcomes. Based on the GDS initiative, we have developed a framework for EE in COVID-19. GDS provides a central repository of resources, experts, and projects to facilitate an interaction design course remotely. These resources are complemented by existing resources (materials in public domain or previously developed by GDS members and local experts, mentors who provided local context to the project). The design outcomes are shared with all GDS members through online tools such as Padlet.

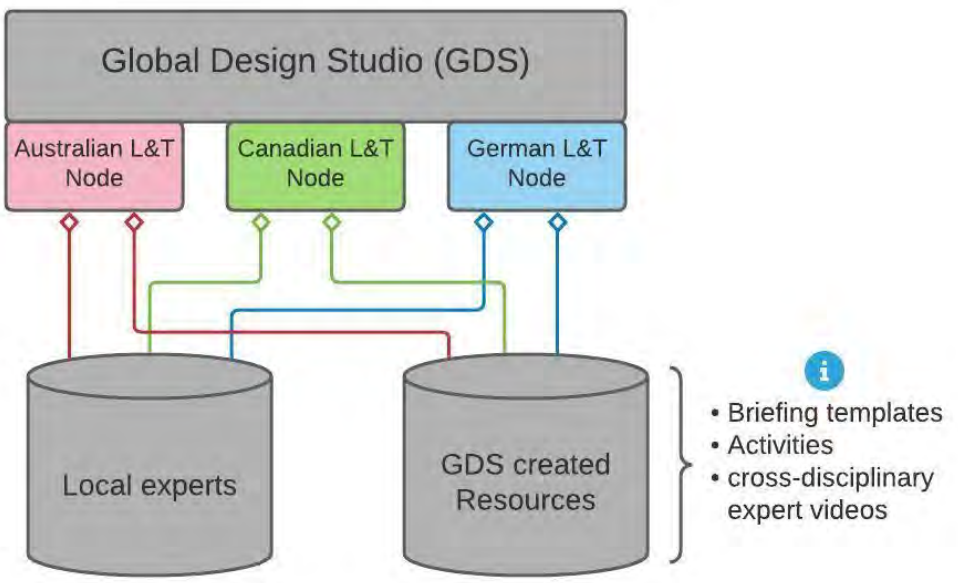

Figure 4. GDS model for cross-disciplinary EE experiential education in COVID-19

Going forward, we will continue to add to the GDS created resources. Attempts will be made to standardize practices and templates with the incorporation of GDS brand. Existing open-source resources on platforms such as YouTube and Vimeo will be added to the repository. We will develop a storage repository to provide easy access to the GDS coordinators and the students. A web platform to house these repositories will be developed which will also allow communication between GDS members and affiliates (experts, students, etc.), and the reporting of the teaching and learning outcomes.

Conclusion

In design disciplines and design studio teaching pedagogies, the COVID-19 pandemic presented ongoing challenges facilitating cross-disciplinary EE and delivering interaction design course content to the students. Through an international collaboration between design courses in Australia, Canada, and Germany, our GDS project provided a collaborative cross-disciplinary remote online platform to facilitate the delivery of content and creation and the sharing of resources for our students. Our GDS model supporting EE comprises collaborative briefing and real-world approach, resource sharing for remote and local activities, and cross-disciplinary collaboration. This model facilitated setup of a real-world project driven by user studies and expert consultations at the three L&T nodes of GDS, communication between the GDS members, student peer collaboration through use of online tools such as Padlet, and the sharing of online resources for teaching, learning, and peer-work.

The key aspects learnt to facilitate online EE in design studio teaching are: the critical importance of peer-to-peer learning in remote and local EE interactions, the relevance of collaborating on the same online platforms to allow cross-disciplinary students' group discussions, and the critical role of EE in offering a learning pathway for students to became experts in their domain knowledge.

Future work will focus on developing a web platform to house the repositories for resources and integrate existing OREs to the platform. We will also aim to standardise aspects of the teaching and learning experience, while maintaining the flexibility of streamlining the course to the local context.

Acknowledgements

This collaborative initiative would not have been possible without the support of Luke Wainwright, Acting Director of Clinical Skills Development Services – Metro North Hospital and Health Service (MNHHS), Australia; Dr. med. Micha Bahr. Director of the Clinic for Pediatric and Adolescent Surgery in Ingolstadt (Germany); Rebecca Boyd– manager of intramural sports, sport clubs, aquatics and first aid (Canada), Melanie Baljko– Professor at Lassonde school of Engineering, York University (Canada), Lisa Endersby and Brian Nairn from Teaching Commons, York University (Canada). We are also thankful to our students for their trust, patience, and hard work put into the project.

References

Baker, A. C., Jensen, P. J., & Kolb, D. A. (2002). *Conversational learning: An experiential approach to knowledge creation*. Greenwood Publishing Group.

Bateni, M. H., Behnezhad, S., Derakhshan, M., Hajiaghayi, M. T., Kiveris, R., Lattanzi, S., & Mirrokni, V. (2017). Affinity clustering: Hierarchical clustering at scale. *Proceedings of the 31st International Conference on Neural Information Processing Systems*, 6867–6877.

Boudhraa, S., Dorta, T., Milovanovic, J., & Pierini, D. (2021). Co-ideation critique unfolded: An exploratory study of a co-design studio 'crit'based on the students' experience. *CoDesign*, *17*(2), 119–138.

Butz, A., Koch, M., & Schlichter, J. (2014). *Mensch und Computer 2014-Tagungsband: 14. Fachübergreifende Konferenz für Interaktive und Kooperative Medien-Interaktiv unterwegs-Freiräume gestalten*. Oldenbourg Wissenschaftsverlag.

Buxton, B. (2010). *Sketching user experiences: Getting the design right and the right design*. Morgan kaufmann.

Cameron, M., Forsyth, A., Green, W. A., Lu, H., McGirr, P., Owens, P. E., & Stoltz, R. (2001). Learning through service: The community design studio. *College Teaching*, *49*(3), 105–113.

Cennamo, K. S. (2016). What is Studio? *Studio Teaching in Higher Education: Selected Design Cases*, 248.

Chamorro-Koc, M., & Kurimasuriyar, A. (2020). Insights from studio teaching practices in a Creative Industries Faculty in Australia. *Arts and Humanities in Higher Education*, *19*(2), 172–185. https://doi.org/10.1177/1474022218802529

Christian, D. D., McCarty, D. L., & Brown, C. L. (2020). Experiential education during the COVID-19 pandemic: A reflective process. *Journal of Constructivist Psychology*, 1–14.

Cook, R., & Cutting, R. (2014). 'Low-impact communities' and their value to experiential Education for Sustainability in higher education. *Journal of Adventure Education & Outdoor Learning*, *14*(3), 247–260.

Crowther, P. (2013). Understanding the signature pedagogy of the design studio and the opportunities for its technological enhancement. *Journal of Learning Design*, *6*(3), 18–28.

El Zeini, I. M., Mansour, H. S., & Eldlaal, F. M. (2021). Spatial post-occupancy evaluation of interior design studio in relation to pedagogy. *Journal of Arts & Architecture Research Studies*, *2*(3), 52–70.

Garrett, J. J. (2010). *The elements of user experience: User-centered design for the web and beyond*. Pearson Education.

Gencosmanoglu, A. B., ENGIN, E., & AYDINTAN, E. (2011). First term interior design studio as a process of teaching, learning and expressing. *Scientific Research and Essays*, *6*(16), 3461–3473.

Greenberg, S., Carpendale, S., Marquardt, N., & Buxton, B. (2011). *Sketching user experiences: The workbook*. Elsevier.

Ham, J. J., & Schnabel, M. A. (2011). Web 2.0 virtual design studio: Social networking as facilitator of design education. *Architectural Science Review*, *54*(2), 108–116.

Hassenzahl, M. (2013). User experience and experience design. *The Encyclopedia of Human-Computer Interaction*, *2*.

Jaye, P., Thomas, L., & Reedy, G. (2015). 'The Diamond': A structure for simulation debrief. *The Clinical Teacher*, *12*(3), 171–175.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Krug, S. (2018). *Don't make me think!: Web & Mobile Usability: Das intuitive Web*. MITP-Verlags GmbH & Co. KG.

Leblanc, T. (2015). Sketching as a thinking process. *DS 82: Proceedings of the 17th International Conference on Engineering and Product Design Education (E&PDE15), Great Expectations: Design Teaching, Research & Enterprise, Loughborough, UK, 03-04.09. 2015*, 606–611.

Machemer, P. L., & Crawford, P. (2007). Student perceptions of active learning in a large cross-disciplinary classroom. *Active Learning in Higher Education*, *8*(1), 9–30.

Meyer, M. W., & Norman, D. (2020). Changing design education for the 21st century. *She Ji: The Journal of Design, Economics, and Innovation*, *6*(1), 13–49.

Mok, Y. (2009). Korea education in the age of knowledge convergence. *Autumn Conference of Korean Educational Research Association*.

Pennington, D. D. (2008). Cross-disciplinary collaboration and learning. *Ecology and Society*, *13*(2).

Roberts, T. G. (2003). *An Interpretation of Dewey's Experiential Learning Theory.*

Rosenzweig, E. (2015). *Successful user experience: Strategies and roadmaps*. Morgan Kaufmann.

Ryan, M., & Ryan, M. (2013). Theorising a model for teaching and assessing reflective learning in higher education. *Higher Education Research & Development*, *32*(2), 244–257.

Schaffer, S. P., Chen, X., Zhu, X., & Oakes, W. C. (2012). Self-efficacy for cross-disciplinary learning in project-based teams. *Journal of Engineering Education*, *101*(1), 82–94.

Schoel, J., & Maizell, R. S. (2002). *Exploring islands of healing: New perspectives on adventure based counseling*. Project adventure.

Self, J. A., & Baek, J. S. (2017). Interdisciplinarity in design education: Understanding the undergraduate student experience. *International Journal of Technology and Design Education*, *27*(3), 459–480.

Self, J. A., Evans, M., Jun, T., & Southee, D. (2019). Interdisciplinary: Challenges and opportunities for design education. *International Journal of Technology and Design Education*, *29*(4), 843–876.

Steane, J. (2014). *The principles and processes of interactive design*. Bloomsbury Publishing.

Strait, J., & Sauer, T. (2004). Constructing experiential learning for online courses: The birth of e-service. *Educause Quarterly*, *27*(1), 62–65.

Tovey, M. M. (2015). *Design pedagogy: Developments in art and design education*. Ashgate Publishing, Ltd.

Vyas, D., van der Veer, G., & Nijholt, A. (2013). Creative practices in the design studio culture: Collaboration and communication. *Cognition, Technology & Work*, *15*(4), 415–443.